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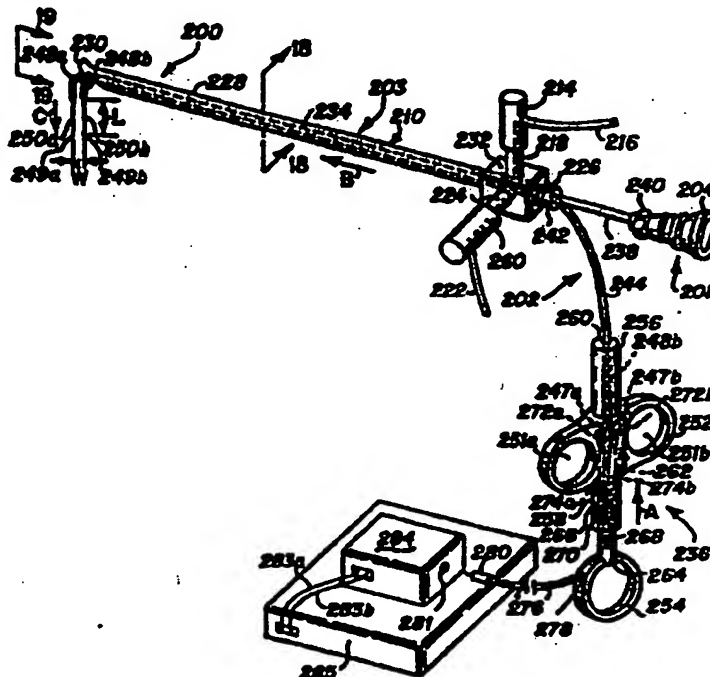
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(21) International Application Number: <b>PCT/US95/09152</b> (22) International Filing Date: <b>12 June 1995 (12.06.95)</b> (30) Priority Data: <b>08/259,712</b> <b>14 June 1994 (14.06.94)</b> <b>US</b> (71)(72) Applicant and Inventor: <b>DESAI, Ashvin, H. [US/US];</b> <b>2195 Trade Zone Boulevard, San Jose, CA 95131 (US).</b> (74) Agent: <b>JAFFER, David, H.; Rosenblum, Parish &amp; Isaacs, PC,</b> <b>15th floor, 160 W. Santa Clara Street, San Jose, CA 95113</b> <b>(US).</b>	(81) Designated States: <b>AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, JP, KR, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, UZ, VN, European patent (AT, BR, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).</b>  Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>	

(54) Title: **ENDOSCOPIC SURGICAL INSTRUMENT**

## (57) Abstract

An endoscopic surgical instrument (201) includes a housing (210), a single access conduit (212) formed in the housing (210), an irrigation port, and an evacuation port, each port being connected through independent valves to the single access conduit (212). The single access conduit (212) has a first end and a second end which is terminated in an aperture formed in the housing (210). A closure is provided for the aperture. A viewing device, such as an endoscope, is insertable through the aperture and the single access conduit (212), and is extended slightly beyond the first end. An electrode assembly (202) having two or more retractable RF electrodes spaced a predetermined distance and angle apart, is also insertable through the aperture and the single access conduit (212), and is extendable beyond the first end. Each RF electrode is in electrical communication with a means for supplying RF energy and for continuously measuring impedance across the electrodes.



1 Specification  
2 ENDOSCOPIC SURGICAL INSTRUMENT  
3

4 RELATED CASES

5 This application is a continuation-in-part of my co-  
6 pending U.S. Patent Application serial No. 08/025,003,  
7 filed March 2, 1993 which is a continuation-in-part of my  
8 co-pending U.S. Patent Application Serial No. 07/779,108  
9 filed October 18, 1991.  
10

11 BACKGROUND OF THE INVENTION

12 Field of the Invention

13 This invention relates to a surgical instrument and more  
14 particularly to an instrument with the capability for  
15 continuous irrigation and evacuation of fluid into and out  
16 from a body cavity of a patient during Laparoscopic or  
17 Endoscopic surgical procedures, and for the simultaneous  
18 measurement of tissue impedance and the ablation of tissue  
19 with fixed or retractable electrodes using R.F. energy.  
20

21 Brief Description of the Prior Art

22 Laparoscopic/endoscopic surgical procedure allows a  
23 surgeon to see inside the body cavity of a patient without  
24 the necessity of large incisions. This reduces the  
25 chances of infection and other complications related to  
26 large incisions. The endoscope further allows the surgeon  
27 to manipulate microsurgical instruments without impeding  
28 the surgeon's view of the area under consideration.

29 During these surgical procedures it is desirable for as  
30 few lines as possible to enter the body of the patient.  
31 This reduces the size of the incision the surgeon needs to  
32 make. It follows from this that the greater the number of  
33 functions provided by a single instrument or the greater  
34 the number of instruments able to be passed through a  
35 single line entering the patient's body, the better.

36 Furthermore, in certain procedures it may be desirable  
37 to irrigate the area under consideration. This in turn  
38 necessitates the evacuation of the irrigation fluid or,

1 moving parts. Similarly if any of the instrumentation is  
2 to be reusable, such instrumentation, including the  
3 valves, should be capable of being efficiently cleaned by,  
4 for example, flushing.

5 United States Patent 4,668,215 (Allgood) discloses a  
6 valve for switching between an evacuation and an  
7 irrigation conduit and allowing both such evacuation and  
8 irrigation to be done via a single line entering the  
9 patient. The mechanism for switching between the  
10 irrigation, evacuation and closed configurations is by  
11 means of a L-valve or T-valve. This patent, in another  
12 embodiment thereof, further provides for a piston valve  
13 for making an on-off connection between an evacuation port  
14 and the line leading into the patient.

15 The L- and T-valves have the disadvantage that they must  
16 be manipulated by rotation by the surgeon, usually using  
17 his/her free hand. The piston valve disclosed in this  
18 patent has the disadvantage that it has many areas where  
19 blood and tissue accumulation and coagulation can occur  
20 which may result in the malfunctioning of the valve. In  
21 addition, the piston valve has numerous "dead" areas where  
22 fluid flow would not occur. This precludes the device  
23 from being effectively cleaned by commonly used flushing  
24 techniques. Finally, the Allgood patent does not disclose  
25 a single body for housing an evacuation/irrigation control  
26 valve together with a housing for laparoscopic and  
27 microsurgical instrumentation.

28 A surgical valve that the applicant is aware of is the  
29 piston valve illustrated in Fig. 1 of the accompanying  
30 drawings.

31 In this valve a piston 10 is located within a cylinder  
32 11. The piston 10 can be moved along the bore of the  
33 cylinder 11 by means of a plunger 12, from a closed  
34 position (as shown) to an open position in which a conduit  
35 13 is aligned with an access port 14. This allows fluid  
36 flow along a path to or from access port 14, via conduit  
37 13 and space 16 from or to a further port 15. Upon

1 monopolar or bipolar radio frequency connector which exits  
2 into the access conduit in such a manner so as to make  
3 radio frequency connection with a probe received by the  
4 probe connector.

5 Preferably the connector for receiving an end, for  
6 convenience called the locating end, of the probe would be  
7 in the form of a receiving bore in the access conduit  
8 which would include a plurality of O-rings which provide  
9 a fluid-tight seal around the locating end of the probe.  
10 These O-rings also function to retain the probe in the  
11 receiving port while allowing the probe to be rotated. In  
12 one embodiment of the invention, the O-rings are, instead  
13 of being located within the receiving bore of the access  
14 conduit, located about the locating end of the probe.

15 This invention also provides for a valve, for use as  
16 either an evacuation or an irrigation valve, the valve  
17 comprising a housing, an activator connected to the  
18 housing, at least a first and a second valve access  
19 conduit, both of which exit into the housing and a fluid  
20 impervious seal mounted within the housing such that  
21 activation of the activator causes the first valve conduit  
22 to move axially relative to the seal and the second valve  
23 conduit such that the seal is disengaged and the conduits  
24 are placed in direct fluid communication with each other.

25 Typically, the instrument of the invention would contain  
26 two of the above described valves. One valve would act as  
27 an evacuator control while the other valve would act as an  
28 irrigation control. Both valves communicate into a single  
29 access conduit which, when the instrument is in use,  
30 continuously flows into the patient via the receiving bore  
31 and the hollow interior of the electrostatic probe.

32 Preferably the endoscopic surgical instrument of the  
33 invention is in the form of a pistol with the "barrel"  
34 portion thereof having, at one end thereof, the receiving  
35 bore for the locating end of the endoscopic probe and, at  
36 the other end thereof, the access port for the  
37 microsurgical instruments and endoscopes.

1 in the art after having read the following detailed  
2 description of the preferred embodiment which is  
3 illustrated in the several figures of the drawing.

4 IN THE DRAWINGS

5 In the following drawings:

6 FIG. 1 is a partial sectional elevation through a prior  
7 art piston valve;

8 FIG. 2 is a diagrammatic section through a semi-exploded  
9 elevation of one embodiment of the endoscopic surgical  
10 instrument of the invention;

11 FIG. 3 is an illustration of a tricuspid valved access  
12 port illustrated in plan (a) and elevation (b) views;

13 FIG. 4 is a section through a receiving bore of the  
14 instrument illustrating one way of locating a probe in the  
15 bore;

16 FIG. 5 is a section through a similar receiving bore  
17 showing a different way of locating a probe in the bore;

18 FIG. 6 is a side view illustrating in (a)-(i) various  
19 electrostatic probe operational ends;

20 FIG. 7 is a section through a valve according to the  
21 invention with the valve being in the shut position;

22 FIG. 8 is the valve of FIG. 7 in the open position;

23 FIG. 9 is a partial section through a different type of  
24 valve also suitable for use in the instrument of the  
25 invention;

26 FIGS. 10, 11, 12 and 13 are diagrammatic illustrations  
27 showing various configurations of valve operating buttons  
28 and triggers;

29 FIG. 14 is an exploded view of an alternative embodiment  
30 of the surgical instrument of the invention illustrating  
31 a disposable valve cartridge;

32 FIG. 15 is a cross section through the disposable valve  
33 cartridge illustrated in Fig. 14;

34 FIG. 16 is a partially sectioned view of another type of  
35 valve which can be used in the surgical instrument of the  
36 invention;

37 FIG. 17 is a perspective view of an alternate embodiment  
38 of the endoscopic surgical instrument having generally

1 this is in the form of a R.F. connector. The advantage of  
2 a R.F. connector is that it is an industry standard and  
3 can be used for connecting the instrument 20 to standard  
4 R.F. energy sources marketed by a number of different  
5 manufacturers.

6 The radio frequency connector 29 exits into the access  
7 conduit 25 where it makes connection with a point 30, on  
8 the locating end 27 of a probe 28 received by the probe  
9 connector 26.

10 The surgical instrument 20 also includes a port 31 which  
11 allows the surgeon to insert microsurgical instrumentation  
12 and viewing devices along the access conduit 25 and the  
13 bore of the hollow probe 28 to exit from the end 32  
14 thereof. The port 31 should provide a fluid-tight seal  
15 when no microsurgical instrumentation is being used with  
16 the surgical instrument 20. This will prevent fluid,  
17 which may be moving along the access conduit 25 to or from  
18 the patient, from leaking.

19 Typically, the access port 31 is in the form of a  
20 commercially available tricuspid valve as illustrated in  
21 FIGS. 3(a) and (b). In these figures, the valve 31 is  
22 shown as being constituted by three segments 32 which in  
23 plan view are wedge-shaped and which together form the  
24 disc shaped sealing portion of the valve. The segments 32  
25 are held together by means of a circumferential ring 33  
26 which biases the three segments 32 together to form a  
27 fluid-tight seal. In use, the microsurgical  
28 instrumentation are inserted through the valve at a point  
29 34 where the apexes of the segments 32 come together.  
30 This insertion forces the elements of the valve apart to  
31 allow ingress of the microsurgical instrumentation. The  
32 effect thereof is shown in broken lines in FIG. 3(b).  
33 When the instrumentation is removed from the valve 31, the  
34 segments 32 are pulled together to form the seal.

35 In FIG. 4 the probe connector 26 is shown to be  
36 constituted by a receiving bore which is coaxial with the  
37 fluid access conduit 25. In practice, the diameter of  
38 this bore would be the same as that of the access conduit



1        FIG. 5 further illustrates an alternative positioning of  
2        the O-rings 36. In this case they are located on the  
3        locating end 27 of the probe 28.

4        From FIGS. 4 and 5, although not shown, it will be  
5        apparent that the diameter of the operational shank 28a of  
6        the probe 28 can be variable. Typically, the probe, as  
7        shown, would have a diameter of 5mm. This diameter can,  
8        however, be increased to 10mm which would be close to the  
9        diameter of the locating end 27 of the probe, as well as  
10       that of the internal bore diameter of the access conduit  
11       25. The advantage of 10mm diameter probes is that the  
12       evacuation of removed tissue and objects such as the gall-  
13       stones can be more effectively achieved. Obviously, when  
14       the bore of the operating shank 28a of the probe, the  
15       locating end 27 and the access conduit 25 are all 10mm in  
16       diameter, the diameter of the evacuation port 22 and its  
17       related valve 24 and connector tube 24a must also be 10mm.

18       In FIG. 6(a) to (i), a side view of number of different  
19       electrode shapes are illustrated. It will be appreciated  
20       that the electrode tips could be either monopolar or  
21       bipolar. In the case of bipolar electrodes, only one  
22       electrode is illustrated since a second electrode is fully  
23       obscured by the visible electrode. These electrode tips  
24       would be located on the operating end of the probe 28.

25       As can be seen from the figure, a number of the tips are  
26       not symmetrical about the longitudinal axis of the probe  
27       28. It is for this reason that it is desirable for the  
28       probe 28 to be mounted on the instrument in such a manner  
29       to allow for a rotation of the probe about its  
30       longitudinal axis. As has been previously indicated, this  
31       will give the surgeon the opportunity of rotating any non-  
32       symmetrical tips, inside the patient, without having to  
33       rotate his or her wrist.

34       This invention extends also to an electrostatic probe  
35       28, substantially as described in any of the FIGS. 4 to 6.

36       The details of one type of irrigation/evacuation valve  
37       are illustrated in FIGS. 7 and 8. The valve 24 indicated  
38       in both figures comprises a housing constituted by a

1        Upon release of the force on the button 51, the bias of  
2        the spring 55 will return the valve to its shut position.

3        It is evident from the construction of the valves  
4        illustrated in FIGS. 7 and 8 that they can be readily  
5        cleaned by commonly used cleaning such as flushing. In  
6        addition, the valves have almost no areas where blood and  
7        tissue accumulation and coagulation can occur, and if such  
8        accumulation and coagulation does occur the valves cannot  
9        be jammed in the open position. This is because the  
10       spring biasing the valve into its closed position is  
11       located in an effectively sealed area. Furthermore these  
12       valves have been tested to a pressure of up to 100 psi  
13       without the integrity of the valve seal being adversely  
14       affected.

15       An alternative form of valve, to that illustrated in  
16       FIGS. 7 and 8 above, is shown in FIG. 9. In the figure  
17       the valve is shown to include a generally cylindrical  
18       valve body 60, an activating button 61 and a plunger 62.  
19       A hollow bore runs down the center of the valve body 60  
20       and contains the valve seal 63. The valve seal 63 is made  
21       up of a circular washer 63a and a sealing O-ring 63b and  
22       is screwed onto the bottom of plunger 62. The valve seal  
23       63 is biased into its illustrated sealing position by  
24       means of a spring 64 located in the bottom part of the  
25       valve body 60.

26       To open the valve, the button 61 is depressed so that  
27       the plunger 62 forces the valve seal 63 downwards against  
28       the bias of the spring 64 to a position shown in broken  
29       lines 63', in the figure. As a result, a fluid path,  
30       indicated by arrows 65, is opened between an upper pair of  
31       cutouts 66 and a lower pair of cutouts 67. Each pair of  
32       cutouts opens into the hollow bore in the center of the  
33       valve body 60 and, when this valve is inserted into the  
34       surgical instrument, into either an evacuation or  
35       irrigation conduit. Closure of the valve is achieved by  
36       releasing the button and allowing the spring 64 to return  
37       the valve seal 63 to the sealing position.

1 button to manipulate the evacuation valve could be concave  
2 while the button for manipulating the irrigation valve  
3 could be convexly shaped.

4 FIG. 13 illustrates still another arrangement of buttons  
5 and valves, in this case an arrangement particularly  
6 suited to the valve shown in FIG. 9.

7 In this figure only the pistol grip 90 of the surgical  
8 instrument of the invention is shown. An irrigation port  
9 92 and evacuation port 94 enter the pistol grip 90 at the  
10 bottom of its handle portion. The ports 92, 94 are, in  
11 use, respectively connected to irrigation and evacuation  
12 conduits (not shown) and, to this end, suitable  
13 connectors, as illustrated, are provided.

14 The irrigation port 93 communicates with the main access  
15 conduit 96 (referenced as 25 in FIGS. 2, 4 and 5) along an  
16 irrigation conduit 98 which extends from the irrigation  
17 port 93 and into the rear of the bore 100 which houses an  
18 irrigation valve 102. From there it extends along the  
19 bore 100 to a point near the front of the bore from where  
20 it exits into the body of the grip 900 to enter rear of  
21 the bore 104 which houses an evacuation valve 106. the  
22 irrigation conduit extends directly across the bore 104 at  
23 this point and becomes a central conduit 108 which  
24 communicates with the access conduit.

25 On the other hand, the evacuation port 94 communicates  
26 with an evacuation conduit 105 which extends along the  
27 pistol grip 90 directly into the front of the bore 104,  
28 down to the bore 104 to its rear from where it exits into  
29 the central conduit 108.

30 In the position shown, both the irrigation and  
31 evacuation valves 102, 106 respectively, are shown in the  
32 off or shut configurations and neither evacuation or  
33 irrigation can take place. Should irrigation of the  
34 patient be required, the dish-shaped irrigation button 110  
35 is depressed and the valve 102 opens (ie. its valve seat  
36 moves to the right in the drawing) to allow irrigation  
37 fluid to pass along the irrigation conduit 98 and into the  
38 bore 104. In this bore 104 the evacuation valve 106 is in

1 of the instrument. When the cartridge 120 is located in  
2 the grip 120 the actuators 132 are located directly below  
3 a pair of operating triggers 140 which can be used to  
4 operate the irrigation/evacuation procedures described  
5 before.

6 Finally, when the cartridge 120 is in place, it is held  
7 there by means of a retainer clip 142 which clips in  
8 behind the cartridge 120. The retainer clip 142 has  
9 apertures 144 formed in it to allow the irrigation and  
10 evacuation pipes 128, 130 to pass through it.

11 Although it will be apparent that the valve types  
12 described above are also suitable for use in the cartridge  
13 120, a further valve configuration is illustrated in FIG.  
14 15, which illustrates the cartridge 120 in greater detail.

15 In this figure, the cartridge 120 is shown to include an  
16 irrigation conduit 150 and an evacuation conduit 152, both  
17 of which lead to a central access conduit 154 which  
18 extends down the center of the male connector 134.  
19 Irrigation and evacuation procedures are controlled by  
20 irrigation and evacuation valves 156 and 158,  
21 respectively.

22 The irrigation valve 156 consists of a valve seal 160  
23 mounted onto a stem which is screwed into an activator  
24 button 132a. A fluid tight seal is provided for the valve  
25 156 by an O-ring 168 mounted onto the cap 132a. The valve  
26 seal 160 seals against a valve seat, formed at the  
27 junction between the irrigation conduit 150 and the  
28 central access conduit 154 and is held in the sealing  
29 position (as shown) by a spring 162.

30 Access to the valve seat is through a hole 164 formed  
31 into the top (as shown in the drawing) of the cartridge  
32 120. This hole 164 can be closed off with a cap 166 and  
33 allows the irrigation valve 156 to be inserted into the  
34 cartridge 120. This is done by inserting the valve seal  
35 160 and its associated stem into the hole 164 from above  
36 and inserting the spring 162 from below. Thereafter the  
37 cap 132a can be screwed onto the stem to hold the entire  
38 valve 156 in place.

1 a fluid path 194 between an opening 196 formed in the  
2 sidewall of the valve body and its lower end. Releasing  
3 the button 186 allows the spring 192 to force the seal 184  
4 back into the closed position.

5 One advantage of this valve is that it is very simple  
6 and inexpensive to manufacture and can, therefore, readily  
7 be disposed of.

8 Finally, it will be apparent to anyone skilled in the  
9 art, that the surgical instrument of this invention could  
10 be made from any suitable material. In the event that the  
11 instrument is intended for single use, plastic material  
12 could be used. Alternatively, for reusable or reposable  
13 instrument, the instrument can be made of a more durable  
14 material.

15 FIG. 17 is a perspective view of an endoscopic surgical  
16 instrument 200 which is an alternate embodiment of the  
17 surgical instrument 20 described above. FIG. 18 is a  
18 partial sectional view of a portion of the instrument 200  
19 taken along the line 18-18 of FIG. 17 and FIG. 19 is  
20 another view of the instrument 200 taken as indicated by  
21 the line 19-19 of FIG. 17. FIG. 20 illustrates the  
22 retractable electrode assembly 202. When viewed together,  
23 FIG. 17-20, illustrate the instrument 200 including an  
24 endoscopic instrument 201, a retractable RF electrode  
25 assembly 202, an continuous irrigation and evacuation  
26 assembly 203, a R.F. energy source 285, and a tissue  
27 impedance monitoring device 284. It will be appreciated  
28 that, although two retractable RF electrodes are  
29 illustrated and subsequently described, in alternate  
30 embodiments the retractable electrode assembly could have  
31 one or more than two retractable RF electrodes. Also,  
32 although a bipolar retractable RF electrode assembly is  
33 illustrated and subsequently described, it will be  
34 appreciated that a monopolar retractable RF electrode  
35 assembly could be used.

36 The assembly 203 includes a housing 210, an irrigation  
37 valve assembly 214, and an evacuation valve assembly 220.  
38 The housing 210 includes an elongated portion 228 having

1 device 284, and a R.F. energy source 285. The sheath 248  
2 is generally parallel to the scope sheath 238. The sheath  
3 248 and the sheath 238 are each insertable into an opening  
4 of an insert flange 242, into the aperture of the handle  
5 portion 232 of the assembly 203. The sheath 248 and the  
6 sheath 238 are insertable within the conduit 212 and are  
7 each of sufficient length such that when each is fully  
8 inserted within the conduit 212, each extends slightly  
9 beyond the tip end 230 of the cylindrical portion 228.

10 The endoscopic instrument or endoscope 201 is  
11 substantially similar to the endoscope instrument  
12 described above, and can be any of a number of devices  
13 known in the prior art. An eyepiece 204 is shown attached  
14 to the endoscope 201. The endoscope 201 is slid into the  
15 scope sheath 238 until the eyepiece 204 engages a flange  
16 240 which is attached to the sheath 238. Thus, the  
17 endoscope 201, and the sheath 248 of the retractable  
18 electrode assembly 202 are both insertable within the  
19 portion 228 of the irrigation and evacuation assembly 203.

20 Each of two RF electrodes 250a, 250b is sheathed within  
21 its respective guide sheath 248a, 248b. Although the  
22 illustrated embodiment depicts two RF electrodes, it will  
23 be appreciated that the assembly 202 could have one or  
24 more than two electrodes. Each electrode 250a, 250b  
25 includes a first or distal end 249a, 249b, a second, or  
26 proximal end 247a, 247b, and a central portion (not shown)  
27 disposedly connected therebetween. A coating of  
28 insulation 246 is disposed onto the bare electrode 250.  
29 The insulation coating 246 may be in the form of a tube of  
30 material (such as teflon) heat shrunk around the bare  
31 electrode 250. Alternately, the insulating coat 246 may  
32 be powder deposited, using vacuum deposition techniques,  
33 onto the bare electrode 250. In either case, nearly the  
34 entire length of the bare electrode 250 is covered by the  
35 insulating coat 246.

36 The electrodes 250a, 250b have a generally constant  
37 diameter throughout its entire length and are sized such  
38 that they can be slid within the sheaths 248a, 248b. That

1 Each connecting pin 272a, 272b is in communication with a  
2 wire 274a, 274b each of which passes through the plunger  
3 264, through an opening 278, and into an insulated line  
4 276 which is terminated in a plug 280 which is matingly  
5 engageable with a receptacle 282 of the tissue impedance  
6 measuring device 284. The R.F. source 285 is in  
7 electrical communication with the impedance measuring  
8 device via electrical lines 283a and 283b. The source 285  
9 and the impedance measuring device 284 are connectable in  
10 parallel in order to get realtime impedance measurement of  
11 tissue engaged between the first ends 249a, 249b of each  
12 of the electrode 250a, 250b.

13 The movement mechanism 236 includes a finger ring  
14 portion 252, and a thumb ring portion 254. The finger  
15 ring portion 252 is a generally flat plate having finger  
16 loops 251a, 251b formed therein. A passage 262 is formed  
17 through the finger ring portion 252 such that the  
18 longitudinal axis of the passage 262 is disposed between  
19 each finger loop and lies coplanar with the plane of each  
20 finger loop. The sleeve 256, and a cylinder 258 are  
21 partially inserted into opposite ends of the passage 262.  
22 The sleeve 256 has a passage longitudinally formed therein  
23 so as to receive the covering 244. The cylinder 258 has  
24 a passage longitudinally formed therein which is aligned  
25 with the passage of the sleeve. The plunger 264 is  
26 slidable within the passage of the cylinder 258. One end  
27 of the plunger is attached to the thumb ring portion 254,  
28 and the connection pins 272a, 272b are mounted to the  
29 other end of the plunger 264. The outer surface of the  
30 plunger 264 is visible through an access cutout 270 formed  
31 in the cylinder 258. In one embodiment, an indicator post  
32 266 is attached to the outer surface of the plunger 264  
33 and passes through the access cutout 270 to give an  
34 immediate visual indication of the position of the plunger  
35 264 within the cylinder 258. In a preferred embodiment,  
36 the outer surface of the plunger 264 is scored with a  
37 plurality of indicator marks 268 to provide a visual  
38 indication of the position of the plunger 264 within the

1 predetermined extension length  $L$  in order to permit the  
2 bare electrode to penetrate a tissue portion up to the  
3 full  $L$  value. Further, the first ends of each needle  
4 electrode are separated by a predetermined separation  
5 width  $W$  (typically 0.1-2.0 cm) and each first end forms a  
6 predetermined angle  $\theta$  with respect to the longitudinal  
7 axis of portion 228. In the illustrated embodiment, the  
8 angle  $\theta$  is 90 degrees. Typical values for  $\theta$  range between  
9 0 and 360 degrees.

10 During surgical procedures, the tip and 230 of the  
11 portion 228 of the instrument 200 is brought adjacent to  
12 a target tissue area of the body cavity. The first ends  
13 of each electrode are extended beyond their respective  
14 sheaths such that each first end is embedded into the soft  
15 target tissue area thereby defining a tissue portion  
16 engaged between the adjacent first ends of each electrode.  
17 The power source is energized and R.F. energy is  
18 transmitted from one electrode to the adjacent electrode.  
19 The energy transmission causes a coagulation of the tissue  
20 portion engaged between the adjacent electrodes and  
21 ablation of the target tissue.

22 Using the present invention, the surgeon can predict and  
23 control the amount of tissue ablation/coagulation with  
24 greater accuracy and safety. As described above, the  
25 spacing between the two parallel first ends of each  
26 electrode remains constant at some predetermined  $W$  value,  
27 e.g. 1.0 cm. Also, the extension of the electrodes beyond  
28 the insulators at a given angle, i.e. the depth of  
29 penetration of each first ends of each electrode into the  
30 soft tissue portion, can be precisely controlled by  
31 observing the indicator marks on the plunger.  
32 Predictable and precise tissue ablation is therefore  
33 possible with the present invention because the depth of  
34 each first end of each electrode in soft tissue can be  
35 precisely controlled by the surgeon. That is, the surgeon  
36 can predict a cylindrical zone of ablation by controlling  
37 the depth of the retractable first ends into the soft  
38 tissue portion. This precise depth control enables the



1 highest value the audible signal decreases in frequency.  
2 In the present invention, the tissue impedance is  
3 monitored or measured on a relative basis. That is, the  
4 impedance measured or monitored is the impedance of the  
5 tissue engaged between the two needle electrodes.

6 FIG. 22A through 22H illustrate alternate electrode  
7 configurations. It will be noted that the preferred  
8 embodiment of the present invention includes two  
9 electrodes with a  $\theta$  of 90 degrees, and a L value of 0-3  
10 cm, and a W value of 0.1-2.0 cm. It will be appreciated  
11 that a variety of electrode configurations, with  
12 associated L, W, and  $\theta$  values within the above specified  
13 ranges, are possible. However, it is generally preferable  
14 to limit the total number of electrodes to six or less.

15 It will be noted that in the embodiments illustrated in  
16 FIG. 22A-22C, 22G-22H, the electrodes 250 are guided by  
17 the shape of the sheath 248. That is, the electrodes can  
18 be directed towards or away from each other if the guide  
19 sheaths are angled towards or away from each other.  
20 Similarly, different  $\theta$  values are possible if the sheaths  
21 are formed with the appropriately angled bands.

22 However, in the embodiments illustrated in FIG. 22D-22F,  
23 the sheaths are substantially straight and the electrodes  
24 themselves are bent in order to direct them in certain  
25 orientations. This feature is more clearly shown in FIG.  
26 23 which illustrates a typical electrode having a bend  
27 formed at the location depicted by numeral 257. When the  
28 electrode is disposed within the sheath 248, the electrode  
29 250 is in contact with at least one portion 259 of the  
30 inner surface of the sheath 248 because of the bend 257.  
31 When the electrode is extended beyond the sheath (shown in  
32 phantom lines), the electrode "flattens" within the sheath  
33 248 while the electrode tip angles away from the sheath  
34 centerline in accordance with the bend 257 formed in the  
35 electrode.

36 FIG. 24 illustrates a retractable electrode surgical  
37 instrument 300 which is an alternate embodiment of the  
38 retractable electrode instrument 200 (FIG. 17). The

CLAIMS

- 1           1.       An endoscopic surgical instrument comprising:
  - 2           a)     a housing;
  - 3           b)     a single access conduit being disposed within said  
4           housing, and having a proximal end and a distal end;
  - 5           c)     an irrigation port formed in said housing;
  - 6           d)     an evacuation port formed in said housing, each of  
7           said irrigation and said evacuation ports being in fluid  
8           communication, through independent valves, with said  
9           proximal end of said single access conduit;
  - 10          e)     an aperture and a closure therefor, said aperture  
11          being formed in said housing, and said closure being  
12          openable to allow the ingress of microsurgical  
13          instrumentation into said proximal end of said single  
14          access conduit; and
  - 15          f)     RF electrode means insertable into said aperture  
16          and into said single access conduit and having a length so  
17          as to protrude beyond said distal end of said single  
18          access conduit, said RF electrode means for engaging a  
19          body tissue portion, and for simultaneously ablating said  
20          body tissue portion and measuring an impedance value  
21          associated with said body tissue portion.
- 1           2.       An endoscopic surgical instrument as recited in  
2           claim 1, wherein said RF electrode means includes:
  - 3           a)     a first RF electrode having a distal end and a  
4           proximal end, said first RF electrode being disposed  
5           within an insulating sheath;
  - 6           b)     elongated guide means encasing said first RF  
7           electrode and said insulating sheath, for guiding said  
8           first RF electrode to a predetermined angle value from the  
9           longitudinal axis of said single access conduit;
  - 10          c)     electrode movement mechanism means, attached to  
11          said proximal end of said first RF electrode, for moving  
12          said first RF electrode within said guide means, said  
13          distal end of said first RF electrode is extendable beyond  
14          an open end of said guide means up to a predetermined

24 within each of associated guide means, and said distal  
25 ends of each of said first RF electrode and said second RF  
26 electrode is extendable beyond and retractable within each  
27 of said associated guide means, and when each of said  
28 distal ends of each RF electrode is extended beyond said  
29 associated guide means said energy source means is  
30 energized to pass electrical current from one RF electrode  
31 to the other and said tissue impedance measurement means  
32 measures the impedance of tissue engaged between each of  
33 said distal ends of each RF electrode.

1 4. An endoscopic surgical instrument as recited in  
2 claim 3, wherein:

3 a) said predetermined angle value is greater than 0  
4 degrees and is less than 360 degrees;

5 b) said second predetermined angle value is greater  
6 than 0 degrees and is less than 360 degrees;

7 c) said predetermined length value is greater than 0  
8 cm and is less than 3 cm;

9 d) said second predetermined length value is greater  
10 than 0 cm and is less than 3 cm; and

11 e) said predetermined width value is greater than 0.1  
12 cm and is less than 2.0 cm.

1 5. An endoscopic surgical instrument as recited in  
2 claim 3, wherein:

3 a) said predetermined angle value is equal to said  
4 second predetermined angle value; and

5 b) said predetermined length value is equal to said  
6 second predetermined depth value.

1 6. A retractable RF electrode assembly for ablating  
2 and measuring the impedance of a body tissue portion,  
3 comprising:

4 a) a first RF electrode having a distal end and a  
5 proximal end, said first RF electrode being disposed  
6 within an insulating sheath;

15 said distal end of said second RF electrode is extendable  
16 beyond an open end of said second guide means up to a  
17 second predetermined length value so as to be engagable  
18 with and insertable into said body tissue portion;

19 d) said proximal end of said second RF electrode is in  
20 electrical communication with said energy source means and  
21 said tissue impedance measurement means; and

22 e) whereby said electrode movement mechanism means  
23 moves each of said first RF and said second RF electrodes  
24 within each of associated guide means, and said distal  
25 ends of each of said first RF electrode and said second RF  
26 electrode is extendable beyond and retractable within each  
27 of said associated guide means, and when each of said  
28 distal ends of each RF electrode is extended beyond said  
29 associated guide means said energy source means is  
30 energized to pass electrical current from one RF electrode  
31 to the other and said tissue impedance measurement means  
32 measures the impedance of tissue engaged between each of  
33 said distal ends of each RF electrode.

1 8. A retractable RF electrode assembly as recited in  
2 claim 7, wherein:

3 a) said predetermined angle value is greater than 0  
4 degrees and is less than 360 degrees;

5 b) said second predetermined angle value is greater  
6 than 0 degrees and is less than 360 degrees;

7 c) said predetermined length value is greater than 0  
8 cm and is less than 3 cm;

9 d) said second predetermined length value is greater  
10 than 0 cm and is less than 3 cm; and

11 e) said predetermined width value is greater than 0.1  
12 cm and is less than 2.0 cm.

1 9. A retractable RF electrode assembly as recited in  
2 claim 8, wherein:

3 a) said predetermined angle value is equal to said  
4 second predetermined angle value; and

10           ii) a guide wire disposed within each of said  
11 guide means and having a first end attached to each said  
12 bellows portion of each of said guide means; and

13           c) whereby actuating said lever tensions each of said  
14 guide wires and varies each of said predetermined and said  
15 second predetermined angle value.

1           14. A retractable RF electrode assembly as recited in  
2 claim 6, further including:

3           a) means for bending said guide means to vary said  
4 predetermined angle value.

1           15. A retractable RF electrode assembly as recited in  
2 claim 14, wherein

3           a) said guide means includes a bendable bellows  
4 portion disposed at a distal end of said guide means;

5           b) said bending means includes

6               i) a lever attached to said housing;

7               ii) a guide wire disposed within said guide means  
8 and having a first end attached to said bellows portion of  
9 said guide means; and

10           c) whereby actuating said lever tensions said guide  
11 wire and varies said predetermined angle value.

1           16. A retractable RF electrode assembly as recited in  
2 claim 7, further including:

3           a) means for bending each of said guide means for each  
4 of said first RF electrode and said second RF electrode to  
5 vary each of said predetermined and said second  
6 predetermined angle values.

1           17. A retractable RF electrode assembly as recited in  
2 claim 16, wherein

3           a) each of said guide means for each said first and  
4 said second RF electrodes includes a bendable bellows  
5 portion disposed at a distal end of each of said guide  
6 means;

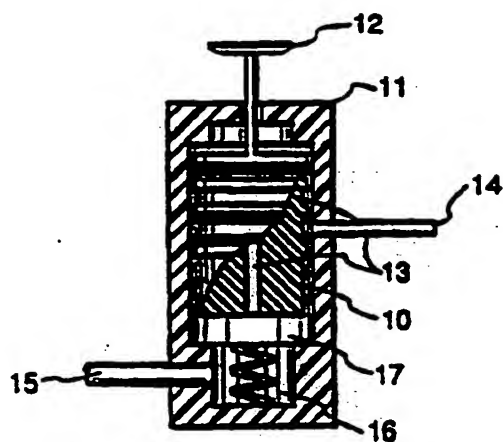


Fig. 1

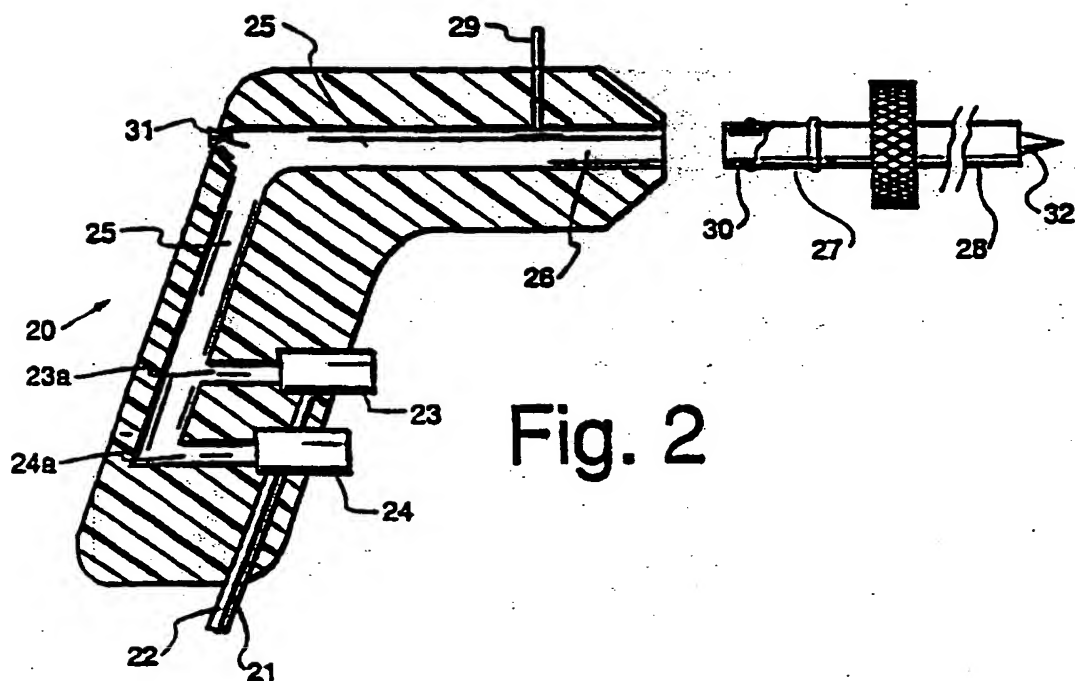


Fig. 2

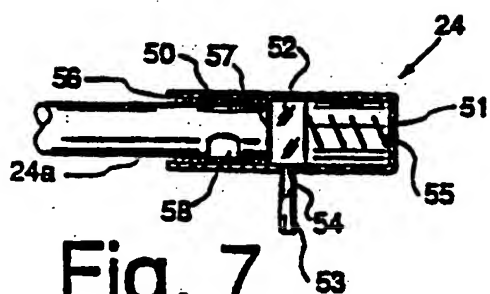


Fig. 7

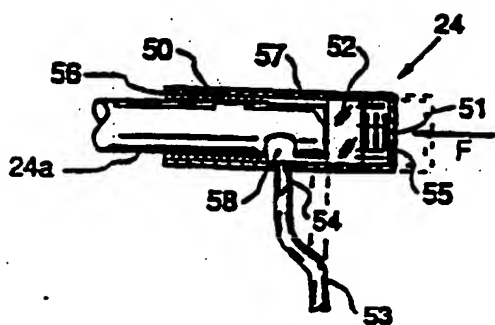


Fig. 8

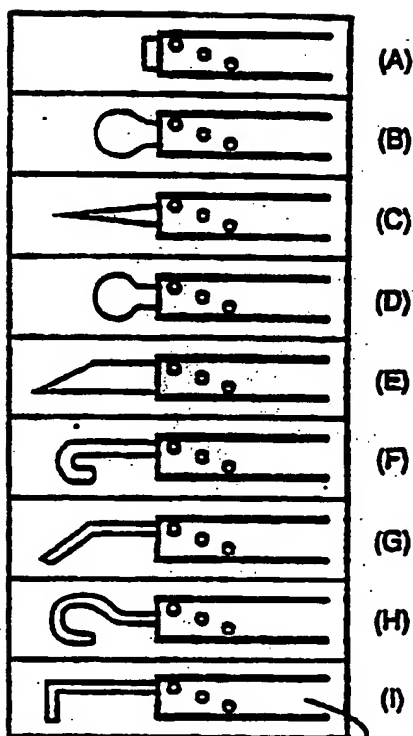
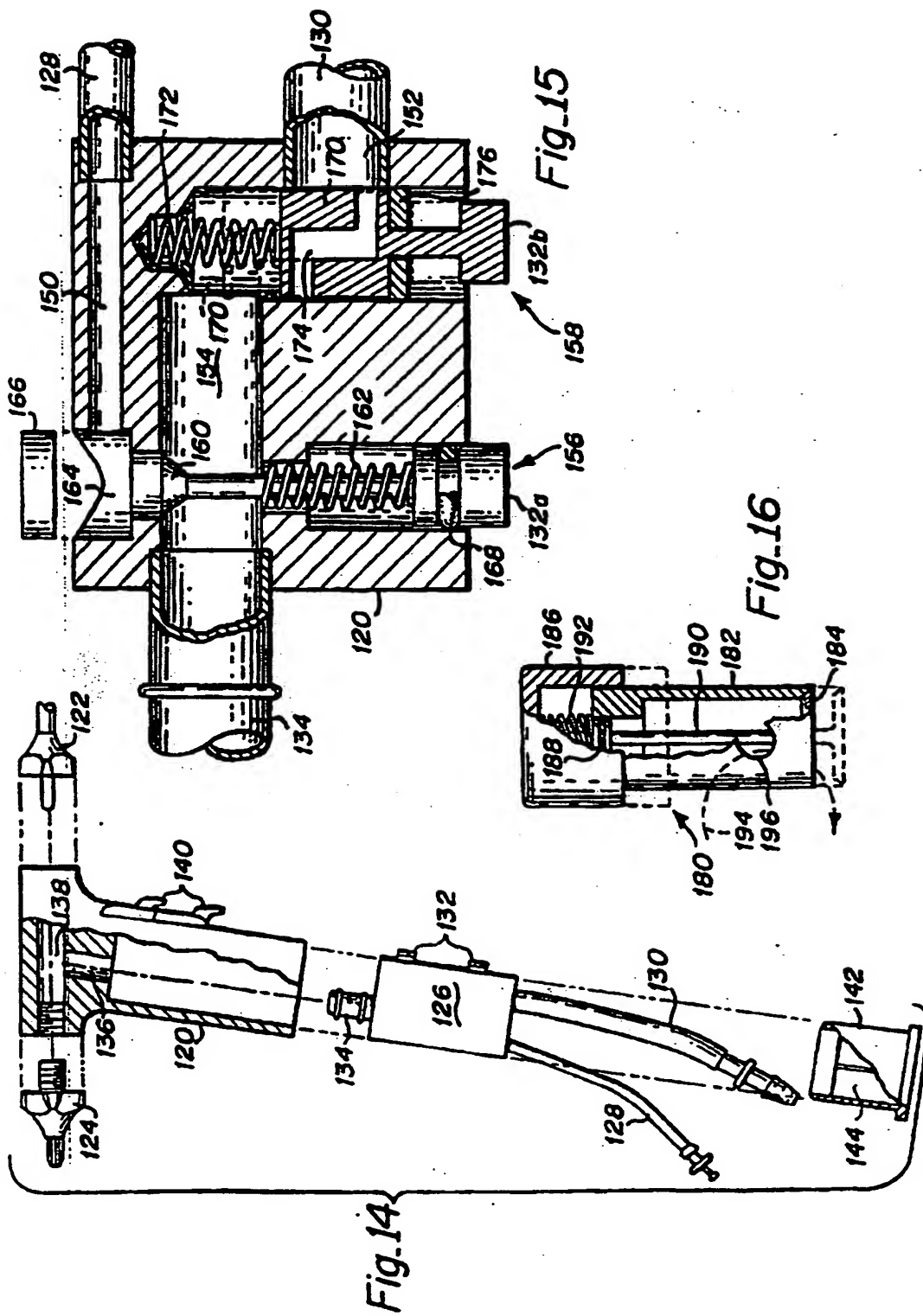


Fig. 6





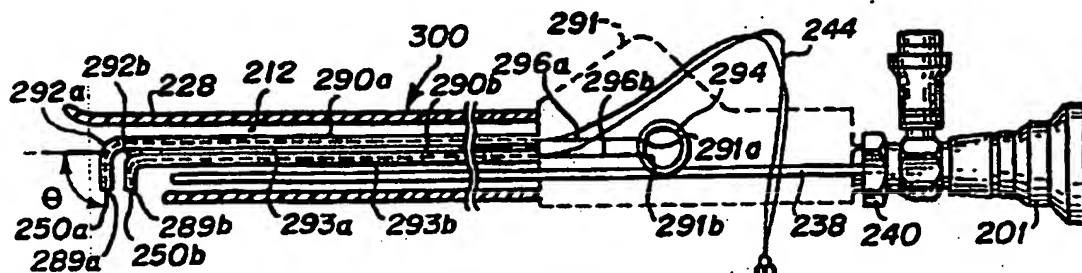
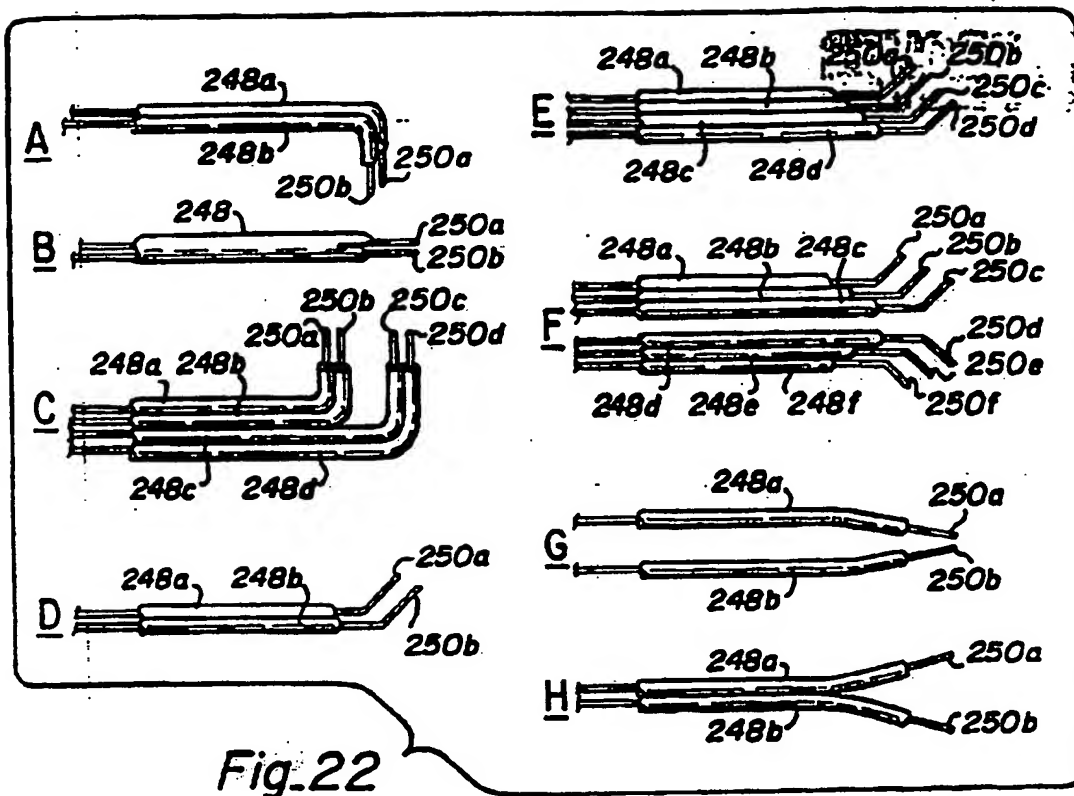


Fig. 24

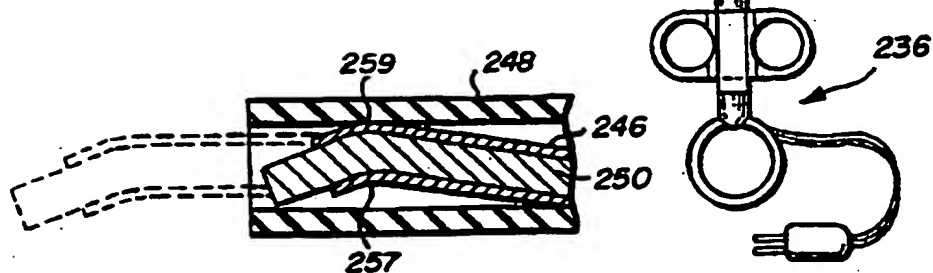


Fig. 23

